

OPTICAL SCIENCE.

A Treatise on Geometrical Optics. By R. A. Herman, M.A., Fellow of Trinity College, Cambridge. Pp. x + 344. (Cambridge: University Press, 1900.)

IN the preface to a recent book dealing with photographic optics, Prof. S. P. Thompson expressed the view that Sir John Herschel's article, "On Light," in the "Encyclopædia Metropolitana" of 1840 marks the culminating point of English writers on optics. Whether this is still the case or not perhaps need hardly be discussed; it may safely be said that Mr. Herman's book, which contains many novel points, constitutes a marked advance, and brings before English students a quantity of information which was not easily accessible to them before.

At the same time, the book undoubtedly suffers as a treatise on the subject from being a text-book for mathematical students at Cambridge. Mr. Herman has aimed at attracting a wide circle of students. The most elementary proofs of the simplest theorems are given alongside of mathematics which require a considerable training to follow easily. The book would have gained as a treatise if the author had assumed his readers to possess some elementary knowledge of the subject and its simplest formulæ. A Cambridge coach might put it in the hands of a beginner, marking, say, two-thirds as to be omitted at first reading; that two-thirds, with some slight re-arrangement and addition, would make a more interesting book for the more advanced student than the actual volume now under review. Thus the theory of geometrical foci, the methods of constructing a figure to find the image of a small object placed perpendicularly to the axis, of a system of spherical reflecting or refracting surfaces and similar problems could all be put more briefly.

In Chapter ix. (General Theorems) we come to Fermat's theorem; the general theory of geometrical foci is here given, based on this theorem. The author remarks that all the theorems hitherto obtained for small pencils passing directly through a coaxial refracting system might be obtained from the formulæ arrived at; the advanced student would have gained a closer grip of the subject as a whole had this course been taken. The formulæ can be extended to establish the collinear relation between the object space and the image space, and, when once this is done, the existence of the principal and nodal points follows, and the geometrical constructions based on a knowledge of their position are easily generalised. The introductory methods of Drude's recent "*Lehrbuch der Optik*" seems, in this respect, more suited to a treatise on the subject than those chosen by Mr. Herman, who appears to have been deterred from using them by his wish to make it clear throughout that the method of geometrical foci is only an approximation. But in spite of this the merits of the book are very great. The author, in his introduction, states that it has been one of his aims

"to introduce a new method of determining the properties of a symmetrical optical instrument in which the angle of divergence of a small pencil, rather than any coordinate of its origin, has been adopted as a leading feature."

The method rests on a combination of Cotes' theorem of the apparent distance, and Helmholtz's expression for the linear magnification.

The simplification that results from its use in the case of a symmetrical pencil traversing a coaxial system of lenses is most marked; the lengthy calculation of the continued fraction by means of which the results are arrived at in Gauss's treatment of the subject is entirely avoided. The application of the method to the determination of the axial aberration of such a system is a striking example of its power; this is easily seen by comparing Chapter viii. (Aberration) with the corresponding portion of some earlier text-book.

In the chapter on instruments the discussion of telescopes is very satisfactory. The same can hardly be said for that on microscopes; probably it would be too much to expect an explanation of the complete theory within the limits of space which could be assigned to the subject, but the discussion should have come after the chapters on aberration and achromatism; it would then have been possible to refer to the problem of the manufacture of suitable glasses which Abbé set himself to solve in 1881—this is alluded to in a perfunctory manner in § 123—and to indicate in a general way the outlines of the theory and the methods in which the defects of one lens are corrected by the next.

The problems to be solved in the construction of photographic lenses can, perhaps, hardly be discussed fully without more complete calculations of the aberrations of oblique pencils than is possible in a general treatise; still, space might have been found for a reference to von Seidel's work, and some discussion of the physical meaning of his five equations of condition would have been interesting and valuable even if the reader had been referred to the original papers for a proof of the conditions. In fact, the book would be improved in many places if the account given of modern German work were more complete; in the chapter on achromatism, for example, full details are supplied of the refractive indices and dispersive powers of several specimens of crown and flint glass; details as to Abbé's glasses, which contain salts of boron, phosphorus and barium, together with some note as to the effects produced on the optical properties of the glasses by these salts, might well have been added. The book is so notable and valuable an addition to the literature of a rather neglected subject, that it is a pity it is not more complete in these respects. It is printed by the Pitt Press in its usual admirable style; the collection of examples, both worked and unworked, is specially full, and will be found very useful to the student. As a text-book it is a marked advance on anything yet published in England.

OUR BOOK SHELF.

By Land and Sky. By the Rev. John M. Bacon, M.A., F.R.A.S. Pp. viii + 275. (London: Isbister and Co., Ltd., 1900.)

MEMBERS of the British Association who were at the Dover meeting may find in this book, among other things, some account of the intentions and the performance of the balloon that occupied for so long a time the grounds of Dover College.

Whether the book was intended to be the British counterpart of its ponderous contemporary in three volumes recently issued by the Aëronautical Society of Berlin does not appear from anything that is written therein. It deals with the same large subject—scientific balloon voyages—but it is not a work of reference. It could hardly be so, for it has no index, and the table of contents serves more to stimulate curiosity with attractive head-lines, as "Marooned" and "How I bombarded London," than to guide the reader to any scientific results. It is not even effective as an indication of what is to be found in the chapters, for what the author has to say, for example, on the natural history of gorse and bracken is to be found in the chapter headed "fog signals."

The leading motive of the book, in so far as it is not autobiographical, is the application of balloon observations to certain problems connected with the transmission of sound, and this leads to spending midnight hours on a tower of St. Paul's, to a long stay at the Maplin Lighthouse, and other eerie expeditions, but to no effective scientific results except the destruction of the author's belief in aerial echoes.

The book has, in fact, all the discursiveness of the *dilettante*. Its scientific investigations lack the definiteness which quantitative measurements give. It describes in one chapter how a certain echo always arrived behind time, but it does not say how the time-table was drawn up. Still, it deals with a number of interesting balloon excursions and the adventures that they afforded; the style is racy in its way, the illustrations are good, and the printer has given effective assistance. The reader will at least learn that ballooning is still in the adventurous stage, and, if he thinks about it, he will conclude that some scientific methods are better than others.

Der Aufbau der Menschlichen Seele; Eine Psychologische Skizze. Von Dr. H. Kroell. Pp. v+392. (Leipzig: Engelmann, 1900.)

DR. KROELL'S work might be judged from two very different points of view. As a popular and generally intelligible account of the present state of our knowledge as to the localisation of function in the brain and the stages of cerebral development, some of his chapters may be highly commended for their clearness and accuracy. As a "psychological sketch" of human life and thought, written with the avowed object of establishing the materialist position, the book is an unqualified failure. Dr. Kroell brings out materialism in his results simply because he has put it into his premisses. He is content to assume the first principles of mechanical physics, not, as a real physicist might do, as working hypothesis, but as unquestionable and ultimate truth. Moreover, he states even those principles in an unsatisfactory way. The difficulties which beset the problem of the relation of matter and energy are ignored by the convenient device of asserting that each is one aspect of a double reality which the author calls "Kraft-stoff"; unfortunately he omits to tell us how "Kraft-stoff" is to be measured. He assumes, with equal recklessness, that all energy is kinetic (p. 28) and (pp. 30, 31) that the phenomena of life *must* be capable of being adequately described in terms of rotatory motion. Dr. Kroell's psychology is of the same type. He can see no difference in principle between the photo-chemical changes produced on the retina by a light-stimulus and the transformation of molecular motion into consciousness which, on his theory, take place in the cortex. The "picture in the brain" is a reality of the same order as the "picture on the retina." That neither "picture," as distinct from its physical conditions, exists except for the eye of an observer does not occur to him. A sensation (p. 70) is actually said to be a cerebral process which has become "conscious of itself," though, of course, our own cerebral processes are in point of fact precisely that of which we

are *never* directly conscious. The sensation as a mental state is confused with its own cortical concomitants and baptised by the name of "picture in the cortex" (p. 98); and the unmeaning question has then to be discussed how it comes about that the "picture in the cortex" is "referred away outside" to the periphery of the body or to a spot in the external world. The questions of animal psychology, which all serious students of the subject know to require the most cautious handling, are settled by Dr. Kroell in the same spirit of jaunty confidence. For instance (p. 125), the higher animals have memory-images. This is roundly affirmed without evidence, apparently in utter ignorance of the actual experimental work which has been done in the study of the animal mind and the much more guarded conclusions to which that work points. Animals (*ib.*) have "concepts," though no word is said as to the evidence which has satisfied the author upon this thorny and debated subject. These are but a few specimens of the confusions of thought and reckless assertions with which the book abounds; they should be enough, however, to indicate the worth of an argument for materialism founded on such premisses. Psychologists have no right to quarrel with physiologists and medical men for not being themselves psychologists; they surely have a right to expect that psychology, as much as any other science, should be protected against the dogmatism of outsiders who disdain to make themselves acquainted with its problems and methods. No knowledge of physiology can give its possessor the right to dogmatise *a priori* in physics and in psychology.

A. E. TAYLOR.

Shakespeare's Greenwood. By George Morley. Pp. xx + 289. Illustrated. 16mo. (London: D. Nutt, 1900.) OF this daintily turned out volume, some portions have already seen the light in an abbreviated form in the columns of *Knowledge*, *Country Life* and the *Art Journal*, but the greater part is new. And the author, who is already known to the public by other descriptions of Warwickshire scenery, claims for his present effort the position of being the only work that deals with the survival of old-time feeling and custom in Shakespeare's country.

Naturally the work is in the main interesting to the antiquarian, the philologist and the student of folk-lore rather than to the zoologist; but there is a chapter on birds from which the ornithologist may possibly glean a few facts in regard to habits and local nomenclature. As an example, we may refer to the incidental statement on p. 194 to the effect that the name "landrail" (like corncrake) is derived from the cry of the bird to which it is applied. It may be that this derivation, although previously unknown to ourselves, is familiar to ornithologists, but we have failed to find mention of it in three standard works on British birds.

The popular superstitions connected with the redbreast and the wren are sympathetically referred to on pp. 153 and 154. And an old-time belief connected with egg-shells is detailed on p. 173. It appears that in Warwickshire it is the custom to scrupulously preserve these, although, at the pain of ill-luck, on no account should they be kept in the house. "But if by any mischance," says our author, "some person, unacquainted with the folk-lore of the subject, should burn the egg-shells, then, in the rustic belief, the hens will cease laying. Where this faith is the strongest is in the isolated homesteads on the waste or by the side of a wood, and there the utmost care is taken to prevent any single egg-shell being thrown into the fire, so that the fecundity of the hens may be stayed." It would be very curious to discover the origin of this and many other strange superstitions referred to by Mr. Morley.

To those of our readers interested in folk-lore, as well as to all Shakespearian students, the elegant little work before us may be heartily commended.

R. L.